Serial No. - 09/992,552
Art Unit - 2855

Amendments to the Claims

The following listing of claims will replace all prior versions, and listings, of claims in the present application:

1. (original) A method wherein mesh insensitive structural stress σ_s in a localized fatigue-prone weld region of a structure is calculated from a finite element model of said structure by:

identifying local elements for structural stress extraction, wherein said local elements lie adjacent to said weld region;

determining nodal displacements and nodal force and moment vectors for said local elements from said finite element model;

converting selected ones of said nodal force and moment vectors to sectional force vectors $\boldsymbol{n}$ and moment vectors $\boldsymbol{m}$, wherein said conversion is performed in a work equivalent manner with respect to said nodal displacements determined for said nodal force and moment vectors; and

calculating said structural stress from said sectional force vectors $\boldsymbol{n}$ and moment vectors $\boldsymbol{m}$.

2. (original) A method as claimed in claim 1 wherein said conversion is performed such that a quantity of work corresponding to said nodal displacements and nodal force and moment vectors is equivalent to a quantity of work for said nodal displacements and said sectional force and moment vectors $\boldsymbol{n}$ and $\boldsymbol{m}$.

3. (original) A method as claimed in claim 1 wherein said nodal force and moment vectors are converted to sectional force vectors $\boldsymbol{n}$ and moment vectors $\boldsymbol{m}$ with a mapping function corresponding to said finite element model.

4. (original) A method as claimed in claim 3 wherein said mapping function is selected such that said sectional force vector $\boldsymbol{n}$ has units of force per unit length and said sectional moment vector $\boldsymbol{m}$ has units of moment per unit length.

5-14. (canceled)

15. (original) A method of analyzing structural stress σ_s in a localized fatigue-prone region of a structure, said method comprising:

identifying local elements for structural stress extraction, wherein said local elements lie adjacent to said localized fatigue-prone region;

determining nodal force and moment vectors for said local elements;

converting selected ones of said nodal force and moment vectors to sectional force vectors n and moment vectors m with an appropriate mapping function, wherein said mapping function is selected such that said sectional force vector n has units of force per unit length and said sectional moment vector m has units of moment per unit length; and

calculating said structural stress utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M$$

where σ_B is proportional to said sectional moment vector m and σ_M is proportional to said sectional force vector n.

16. (original) A method of analyzing structural stress as claimed in claim 15 wherein said structural stress is calculated utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M = \frac{12mz}{t^3} + \frac{n}{t}$$

where t corresponds to the thickness of said structure in said fatigue-prone region and

$$-(t/2) \leq z \leq +(t/2).$$

17. (original) A method of analyzing structural stress as claimed in claim 15 wherein said nodal force and moment vectors are retrieved directly from a finite element model of said structure.

18. (original) A method of analyzing structural stress as claimed in claim 15 wherein said nodal force and moment vectors are determined by generating a stiffness matrix for said

local element from a finite element model of said structure and computing said nodal force and moment vectors from said stiffness matrix.

19. (original) A method of analyzing structural stress as claimed in claim 15 wherein said nodal force and moment vectors are determined by:

generating from a finite element model of said structure stiffness matrices and nodal displacements for the local elements in said fatigue-prone region;

multiplying said stiffness matrices and said nodal displacements to obtain global nodal force and moment vectors at nodal points of said local elements; and

transforming global force and moment vectors from the global coordinate system to the local coordinate system of an element of interest.

20. (original) A method of analyzing structural stress as claimed in claim 15 wherein said nodal force and moment vectors are determined by transforming stiffness matrices and nodal displacements to global and local coordinates and solving for force and moment vectors of said local element.

21. (original) A method of analyzing structural stress as claimed in claim 20 wherein said global coordinates of said stiffness matrices and nodal displacements are used to determine nodal force and moment vectors of said local element of interest.

22. (original) A method of analyzing structural stress as claimed in claim 15 wherein said fatigue-prone region includes a weld and wherein said mapping function is selected according to characteristics of said weld.

23. (original) A method of analyzing structural stress as claimed in claim 15 wherein said mapping function is a linear function.

24. (original) A method of analyzing structural stress as claimed in claim 23 wherein said mapping function defines a magnitude that progresses linearly from a minimum value to a maximum value between adjacent nodes of said local element.

25. (original) A method of analyzing structural stress as claimed in claim 24 wherein said mapping function is a non-linear function.

26. (original) A method of analyzing structural stress as claimed in claim 24 wherein said mapping function is a bi-linear mapping function comprising a combination of a first linear mapping function from a first node N_1 to a virtual node N_3 and a second linear function from said virtual node N_3 to a second node N_2.

27. (original) A method of analyzing structural stress σ_s in a localized fatigue-prone region of a structure from a three-dimensional finite element solid model of the structure, said method comprising:

identifying a group of elements for structural stress extraction, wherein said local elements lie adjacent to said localized fatigue-prone region;

determining nodal forces for said local elements from said finite element solid model of said structure;

converting selected ones of said nodal force vectors to equivalent sectional forces and moments along a selected cross section including said localized fatigue-prone region; and

calculating said structural stress utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M = \frac{12mz}{t^3} + \frac{n}{t}$$

where m comprises a sectional moment vector, n comprises a sectional force vector, t corresponds to the thickness of said structure in the fatigue-prone region, and z ranges from $+t/2$ at a top surface of said structure to $-t/2$ at a bottom surface of said structure.

28-31. (canceled)

32. (original) A computer-readable medium encoded with a computer program for analyzing structural stress σ_s in a localized fatigue-prone region of a structure, said program being operative to:

identify local elements for structural stress extraction, wherein said local elements lie adjacent to said localized fatigue-prone region;

determine nodal force and moment vectors for said local elements;

convert selected ones of said nodal force and moment vectors to sectional force vectors $\boldsymbol{n}$ and moment vectors $\boldsymbol{m}$ with an appropriate mapping function, wherein said mapping function is selected such that said sectional force vector $\boldsymbol{n}$ has units of force per unit length and said sectional moment vector $\boldsymbol{m}$ has units of moment per unit length; and

calculate said structural stress utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M$$

where σ_B is proportional to said sectional moment vector $\boldsymbol{m}$ and σ_M is proportional to said sectional force vector $\boldsymbol{n}$.

33. (original) A computer-readable medium encoded with a computer program for analyzing structural stress σ_s in a localized fatigue-prone region of a structure, said program being operative to:

identify a group of elements for structural stress extraction, wherein said local elements lie adjacent to said localized fatigue-prone region;

determine nodal forces for said local elements from said finite element solid model of said structure;

convert selected ones of said nodal force vectors to equivalent sectional forces and moments along a selected cross section including said localized fatigue-prone region; and

calculate said structural stress utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M = \frac{12mz}{t^3} + \frac{n}{t}$$

where $\boldsymbol{m}$ comprises a sectional moment vector, $\boldsymbol{n}$ comprises a sectional force vector, t corresponds to the thickness of said structure in the fatigue-prone region, and z ranges from $+t/2$ at a top surface of said structure to $-t/2$ at a bottom surface of said structure.

34-35. (canceled)

36. (currently amended) A system for analyzing structural stress σ_s in a localized fatigue-prone region of a structure, said system comprising ~~including a controller programmed to~~:

a programmable controller programmed to

identify local elements for structural stress extraction, wherein said local elements lie adjacent to said localized fatigue-prone region;

determine nodal force and moment vectors for said local elements;

convert selected ones of said nodal force and moment vectors to sectional force vectors $\boldsymbol{n}$ and moment vectors $\boldsymbol{m}$ with an appropriate mapping function, wherein said mapping function is selected such that said sectional force vector $\boldsymbol{n}$ has units of force per unit length and said sectional moment vector $\boldsymbol{m}$ has units of moment per unit length; and

calculate said structural stress utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M$$

where σ_B is proportional to said sectional moment vector $\boldsymbol{m}$ and σ_M is proportional to said sectional force vector $\boldsymbol{n}$.

37. (currently amended) A system for analyzing structural stress σ_s in a localized fatigue-prone region of a structure, said system comprising ~~including a controller programmed to~~:

a programmable controller programmed to

identify a group of elements for structural stress extraction, wherein said local elements lie adjacent to said localized fatigue-prone region;

determine nodal forces for said local elements from said finite element solid model of said structure;

convert selected ones of said nodal force vectors to equivalent sectional forces and moments along a selected cross section including said localized fatigue-prone region; and

calculate said structural stress utilizing the following equation

$$\sigma_S = \sigma_B + \sigma_M = \frac{12mz}{t^3} + \frac{n}{t}$$

where m comprises a sectional moment vector, n comprises a sectional force vector, t corresponds to the thickness of said structure in the fatigue-prone region, and z ranges from $+t/2$ at a top surface of said structure to $-t/2$ at a bottom surface of said structure.

38-47. (canceled)

48. (currently amended) A device comprising:

a computer-readable medium encoded with a computer program for calculating structural stress σ_s in a localized fatigue-prone weld region of a structure from a finite element model of said structure, said program being operative to:

identify local elements for structural stress extraction, wherein said local elements lie adjacent to said weld region;

determine nodal displacements and nodal force and moment vectors for said local elements from said finite element model;

convert selected ones of said nodal force and moment vectors to sectional force vectors n and moment vectors m, wherein said conversion is performed in a work equivalent manner with respect to said nodal displacements determined for said nodal force and moment vectors; and

calculate said structural stress from said sectional force vectors n and moment vectors m.

49. (currently amended) A system for calculating structural stress σ_s in a localized fatigue-prone weld region of a structure from a finite element model of said structure, said system comprising ~~including a controller programmed to~~:

a programmable controller programmed to

identify local elements for structural stress extraction, wherein said local elements lie adjacent to said weld region;

determine nodal displacements and nodal force and moment vectors for said local elements from said finite element model;

convert selected ones of said nodal force and moment vectors to sectional force vectors ***n*** and moment vectors ***m***, wherein said conversion is performed in a work equivalent manner with respect to said nodal displacements determined for said nodal force and moment vectors; and

calculate said structural stress from said sectional force vectors ***n*** and moment vectors ***m***.